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Jesse Pino Profile

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Jesse Pino
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How I chose my profession:

Physics appealed to me from a young age as a way of describing nature. The dream of fusion energy and the coolness of astrophysics lead me to study Plasma Physics.

Education:

Ph.D. in Plasma Physics, University of Texas at Austin, 2009

B.S. w/ Honors in Physics, California Institute of Technology, 2003

Awards:

Graduate Fellowship in Fusion Energy Sciences, US Dept. of Energy/ORISE, 2003-2006

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Since coming to the Lab in 2010, I've been learning about ICF and Stockpile Stewardship. I love being able to apply my physics knowledge to real world applications in support of both Basic Science and National Security.

Probing ICF Plasmas (better section heading?):

The conditions at the center of an inertial fusion energy experiment are unlike anywhere else on Earth. The gas within the rapidly compressed capsule becomes plasma, in which the electrons and ions are no longer bound together. If the shock is strong and fast enough, the common assumption of Local Thermodynamic Equilibrium (LTE) is violated, and the electrons and ions can have very different temperatures.

The National Ignition Facility (NIF) at Lawrence Livermore National Laboratory (LLNL) presents a unique new capability to probe non-LTE plasmas and explore the nature of the electron-ion coupling. The goal of this research campaign is to field capsules with thin glass shells ($\sim 5\mu\text{m}$ thick, $\sim 2\text{mm}$ diameter) in the Polar Direct Drive (PDD) configuration, in which NIF's 192 lasers directly strike the capsule surface. This illuminates the surface with an intensity of $\sim 10^{15} \text{ W/cm}^2$, rapidly ablating the shell and driving a strong converging shock toward the center of the capsule. Ion temperatures of $>15 \text{ keV}$ and electron temperatures of $>5 \text{ keV}$ are reached. A small convergence ratio (~ 4) and rapidly ablated shell reduce susceptibility to hydrodynamic instabilities lead to clean observations of the plasma. During the time of peak emission, the fairly flat radial temperature profiles mean that time-resolved measurements of the ion temperature (by neutron time-of-flight) and electron temperature (by x-ray spectroscopy using a Kr dopant) can be made without being overwhelmed by spatial gradients.

Extensive work has been done to examine the design space with 1D ARES Arbitrary Lagrangian-Eulerian Radiation Hydrodynamics simulations to find the most favorable capsule configurations. However, one of the major challenges of the PDD

approach is achieving a spherically uniform implosion. The standard configuration at NIF is for Indirect Drive, where beams enter the ends of a cylindrical hohlraum to produce an x-ray drive. For PDD, each of the beams must be 're-pointed' away from their nominal angles. Each beam can also have a separate power profile and focal length. Large ensembles of 2D simulations were run to probe the parameter space and find the optimal pointing resulting in the most spherical implosions. The amount of laser energy inevitably lost by beams missing the capsule as it implodes was also quantified, in order to separate this effect from other yield-reducing processes such as gas-shell mixing. The first experiments based on these design calculations will hopefully be fielded in FY2013.

A Blind Study

Jesse recently had the opportunity to participate in a Blind Study to assess the impact of a limited set of legacy data on the design process. A team of recently hired and relatively inexperienced WCI-AX Design Physicists (Jesse Pino, Paul Demange, Kumar Raman, and Bryan Johnson) was tasked with attempting to design a weapon component with limited time and resources. After coming up with a proposed design, the team was given an additional amount of underground test data, and an assessment was made about how useful that data was in changing the proposed design or establishing confidence that it would perform.

The benefits of this exercise exceeded the primary goal; the reevaluation of the legacy data proved insightful in its own right. In addition, the exercise was educational for the participants, challenging them to think about the principles of design in ways that don't often come up in traditional Stockpile Stewardship modeling.

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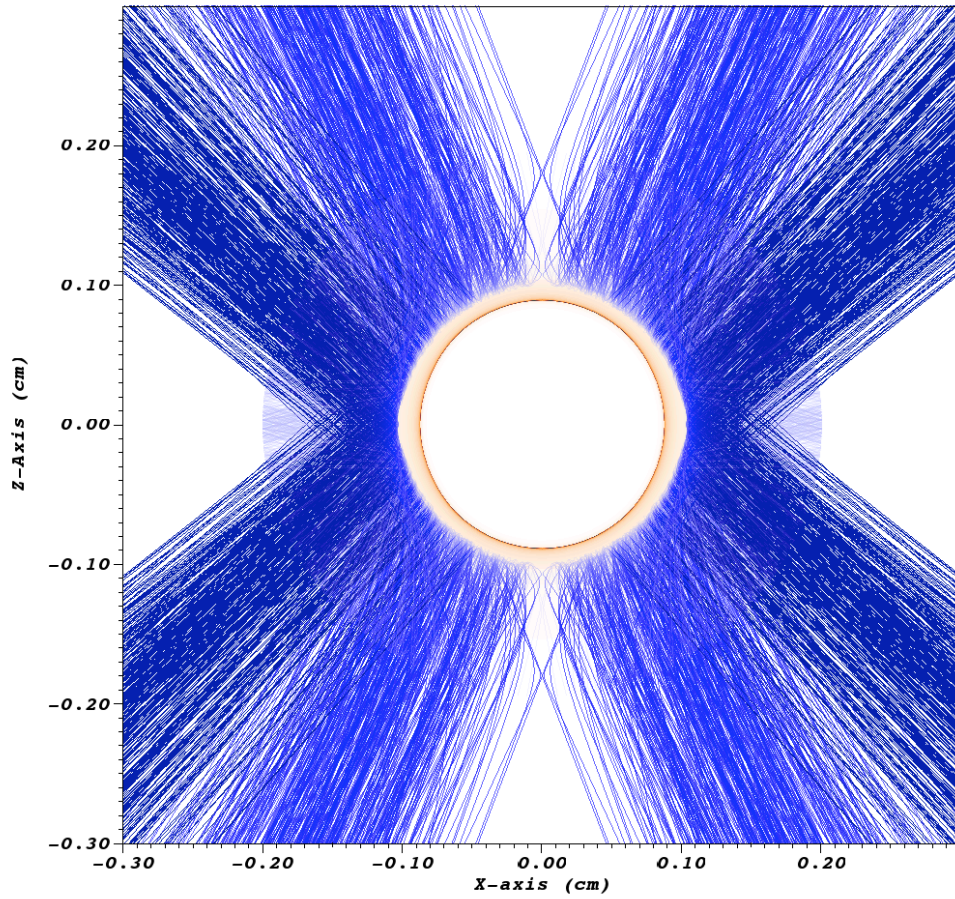


Figure Caption:

An example 2D simulation showing the NIF lasers repointed to produce a spherically uniform implosion.